Department of
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Bureau of Land & Water Quality January, 2003

O&M Newsletter

A monthly newsletter for wastewater discharge licensees, treatment facility operators and associated persons

Clarifier Performance

This month, we are starting a new series of articles on secondary clarifier performance. The secondary clarifier is the most important part of the secondary treatment process. Unless the biological material in the mixed liquor can be separated from the clean water, it is likely that both the BOD and TSS limits will be violated. The purpose of this series of articles is to help you better understand how clarifiers work and how you, as the operator in control of the process, can adjust the operation of your clarifiers to make them as efficient as possible.

The first thing we need to understand about clarifiers is the principle of Mass Balance. Simply stated, whatever goes into a clarifier must come out, be that water or solids. In a clarifier, we want the solids to go out the bottom, to be returned or wasted, and the clean water to be discharged over the weirs carrying a few solids as possible. The mass of solids entering the clarifier is the product of the flow times the mixed liquor solids concentration (MLSS). The flow coming into the clarifier is the sum of the influent flow and the return flow (Q_I and Q_R). So we can write an equation for the mass of solids entering a clarifier as:

$$Solids\ Mass\ In = (Q_I + Q_R)\, x\, MLSS$$

The mass of solids leaving the clarifier is the sum of three flow streams, the effluent, the return activated sludge (RAS) and the waste activated sludge (WAS).

$$Solids\ Mass\ Out = (Q_E\ x\ Effluent\ TSS) + (Q_R\ x\ RAS) + (Q_W\ x\ WAS)$$

For most activated sludge systems the influent flow (QI) and the effluent flow (QE) are equal and we'll replace them in the equations above by Q. Since what comes into the clarifier must go out, the two equations are equal and thus:

$$(Q + Q_R)\, x\, MLSS = (Q\, x\, Effluent\ TSS) + (Q_R\ x\ RAS) + (Q_W\ x\ WAS)$$

Since the amount of sludge lost in the effluent is (we hope) very small and the amount of sludge wasted is small compared to the mass of sludge in the clarifier influent and return flows, we can remove those two terms from the right hand side of the equation leaving:

$$(Q + Q_R)\, x\, MLSS = (Q_R\, x\, RAS)$$

If we do a little math, we can rearrange this equation to the following:

$$RAS = [(Q / Q_R + 1]\, x\, MLSS$$

This equation tells us several important things:

? Since $[Q/Q_R + 1]$ is always greater than 1, the return sludge (RAS) concentration will always be higher than the MLSS concentration.
? To get a concentration higher than the MLSS concentration, there must be some settling. This happens at or near the floor of the clarifier and regardless of the hydraulics of the tank, there will always be a sludge blanket.
? If you don't change the return flow, the RAS concentration will increase as the influent flow increases and decrease when the influent flow decreases.
? If you waste from your RAS line, the sludge will be thicker if you waste at a time when the flows are higher.
? Increasing RAS flows decreases the concentration of the RAS. Thus, while you may think that coning or "rat-holing" causes decreased RAS concentration, it is probably the result of the system maintaining the mass balance.
? The equation shows clearly that keeping the RAS flow at a constant percentage of the influent flow maintains the RAS concentration constant. That will, in
? turn, give a much more consistent operation.

By looking the mass balance in the clarifier, we see that there is a clear relationship between the influent and return flows and the concentration of the RAS. Changing RAS flows to maintain a constant percentage of the influent flows helps provide a more constant environment for the bugs which will help them do their work better and help us look good.

Next month, we'll start to look at something called State Point Analysis. This is a tool that builds on the concept of mass balance. Properly used, it can give you information about how much flow you can safely put through a clarifier without washout and permit violations.

For Practice

1. A new industry is planning to locate in your town and will be discharging process water to your treatment facility. You get a sample of process water from another factory that has the same pollutants in the same quantities as the water that will be come into your facility. You mix some of the sample with some of your present influent in the same ratio that you expect when the new factory comes on line. When you run an OUR test on this mixture, you note that the respiration rate decreases dramatically. This indicates:
    a. The mixture is toxic to the mixed liquor.
    b. The sample is over aerated.
    c. The MLSS must be decreased to accept this waste.
    d. The new waste may require additional aeration to stabilize.

2. Your discharge license requires you to store wastewater in your lagoon for 150 days in the winter. If you have an average influent flow of 127,500 gallons/day and a total pond area of 23.42 acres (1,020,000 sq.ft.), how much freeboard do you need in your 5-foot deep lagoon?
    a. 0.5 ft.
    b. 1.5 ft.
    c. 2.5 ft.
    d. 3.5 ft.

3. The term "return sludge" usually refers to sludge from:
    a. Primary Clarifiers
    b. Secondary Clarifiers
    c. Aerobic Digesters
    d. Anaerobic Digesters

4. Which waterborne disease is not caused by a virus?
    a. Hepatitis
    b. Cholera
    c. AIDS
    d. Smallpox

Fall Exam Results

The results of the latest certification exam given on November 13, 2002 are in. The results were much worse overall than for the Spring exam. The following is a breakdown of the pass rate for the different grade exams

Grade 1	4 of 14	29%
Grade 2	5 of 11	45%
Grade 3	2 of 10	20%
Grade 4	3 of 7	43%
Grade 5	1 of 20	5%
Grade PC-1	2 of 2	100%
Overall	17 of 64	27%

Operator Certification Renewals

Certified Operators who have ***odd numbered*** certificates will be due for renewal by March 1, 2003. Those operators will receive their renewal notices in early January. To renew your certificate, you need to show proof of at least 18 hours of approved training and pay the renewal fee of $20.00. If you are due to renew in 2003 and do not have enough training and cannot take the required 18 hours before March 1, 2003, submit your renewal form and renewal fee before March 1st. Include a letter stating when you will be taking the training to meet the training requirement. If we do not hear from you bay March 1, 2003, your certification will become inactive. If you are the operator in responsible charge of your treatment facility, it will be illegal for you to sign the DMR or Form 49 until you reactivate your certificate.

Approved Training

January 14, 2003 in Waterville, ME – Wastewater Solids Management – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
January 16 & 23 & February 6 & 13, 2003 in Rockland, ME – NPDES Laboratory Class – Sponsored by MWRA, (207) 729-6569 – Approved for 16 hours.
*****
January 22, 2003 in Lincoln, ME – Wastewater Laboratory Review – Sponsored by MWRA, (207) 729-6569 – Approved for 3 hours.
*****
January 28, 2003 in Waterville, ME – Presque Isle – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
February 6, 2003 in Topsham, ME – Disinfection – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
February 20, 2003 in Presque Isle, ME - Basic Excel for Water & Wastewater Operators - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
February 25, 2003 in Bangor, ME – PPE to include an exercise on PPE Assessment – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
February 25, 2003 in Presque Isle, ME - Pump System Drives & Motors for Water & Wastewater Operators - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
February 26, 2003 in Houlton, ME – PPE to include an exercise on PPE Assessment – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
February 26, 2003 in Old Orchard Beach, ME – Wastewater & Collection System: Planning, Operation & Maintenance – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
February 26, 2003 in Kittery, ME – Instrumentation & SCADA – Sponsored by NEIWPCC, (978) 323-7929 – Approved for 6 hours.
*****
March 5, 2003 in Hallowell, ME – PPE to include an exercise on PPE Assessment – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
March 6, 2003 in Portland, ME - Basic Water & Wastewater Math for Water & Wastewater Operators - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
March 12, 2003 in Livermore Falls, ME Phosphorus Removal, BNR, Phosphate Control - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
March 12, 2003 in York, ME – PPE to include an exercise on PPE Assessment – Sponsored by MWRA, (207) 729-6569 – Approved for 4 hours.
*****
March 18, 2003 in Vassalboro, ME - Basic Chemistry - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
March 27, 2003 in Bangor, ME - CMOM & New Stormwater Rules - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****

April 9, 2003 in Presque Isle, ME - Using Advanced Technologies to Maintain Compliance Though residual control - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
April 15, 2003 in Augusta, ME - Seeded BOD, E. -Coli, Solids and Microscopic Examination – A hands on lab review - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
April 30, 2003 in Brewer, ME - Confined Space Entry - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
May 8, 2003 in Presque Isle, ME – Wastewater Certification Exam Review Grades IV-V – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
*****
May 6, 2003 in Saco, ME - Physical Chemical Wastewater Treatment - Sponsored by JETCC, (207) 253-8020 – Approved for 6 hours.
*****
May 7, 2003 in Augusta, ME – Wastewater Certification Exam Review Grades I-III – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
*****
May 8, 2003 in Bangor, ME – Wastewater Certification Exam Review Grades I-III – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
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May 1, 2003 in Bangor, ME – Wastewater Certification Exam Review Grades IV-V – Sponsored by MWRA, (207) 729-6569 – Approved for 6 hours.
*****
May 21&22, 2003 in Bangor, ME, - Basic Lab Procedures w/ NEWEA Exam - Sponsored by NEIWPCC, (978) 323-7929 – Approved for 10 hours.

Spring Certification Exam Notice

Note that the Spring certification exam will be given on May 14, 2003. Applications for that exam must be ***postmarked by March 29, 2003 or received by March 31, 2003***. If you missed out on the Fall exam, study up and take it in the Spring

Answers to *For Practice:*

1. a A dramatic decrease in the respiration rate indicates that the mixed liquor is not using the new waste as food, requiring more oxygen. This usually indicates the presence of a material that is toxic to your sludge. You may have to require removal of the toxic material or your sludge may gradually acclimate itself to the new material.

2. c 127,500 gal/day * 150 days = 19,125,000 gals
19,125,000 gals / 7.5 cu. ft./gal = 2,550,000 cu. ft.
2,550,000 cu. ft. /1,020,000 sq. ft. = 2.5 ft of freeboard
You would need to draw down your lagoon so that less than 2.5 feet of water remained in the lagoon at the beginning of the storage season.

3. b Return sludge is the settled mixed liquor containing active microorganisms, which is returned to the aeration basin from the secondary clarifiers.

4. b Cholera is caused by a bacteria. Viruses cause all the other diseases.